Cement MILL SECTION of
Concrete
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Three Forks Company Operates New Sand and Gravel Plant

By E. U. Leh

The new sand and gravel plant of the Three Forks Portland Cement Co. is situated on the three forks of the Missouri River. The gravel deposit, of approximately 20 ft. in depth, in the river, is the wash of the Gallatin, Jefferson and Madison rivers, which unite at this point and form the Missouri River. It is of excellent quality, no sandstone or soft material being present. The gravel has been brought down by the different rivers for many years, and at a great distance, therefore the deposit is the survival of the fittest. No better material as aggregate for concrete purposes can be found anywhere.

The capacity of the plant is 500 tons per day. The material is taken from the deposit by means of a drag line bucket of 3 yds. capacity, operated by 125 h. p. Allis-Chalmers double drum electric hoist.[1] The drag line cable is 1 in. in diameter and travels at a speed of 250 ft. per minute. The return cable is ¾ in. in diameter and travels at a speed of 400 ft. per minute.

The sand and gravel is dragged in by this equipment and dumped into a receiving hopper from which it is fed by a Stephens-Adamson 24 in. x 54 in. pan feeder[2] on to a 20 in. belt conveyor, which is inclined, and elevates the material to a 48 in. x 14 ft. Allis-Chalmers scalping screen with 2½ in. perforations. At the discharge end of this screen is a No. 5 Symons gyratory crusher.[3] All material which passes through the 2½-in. perforations is spouted on to a 20-in. inclined belt conveyor, which is located directly under the scalping screen. The material which is repected from the screen is discharged direct into the No. 5 B Symons crusher, and is crushed to 1½ in. and finer. This material also discharges on to the same belt conveyor, which is 240 ft. long and inclined to elevate the material to the washing plant.

The pan feeder, belt conveyor, scalping screen and the No. 5 crusher are operated by a 50 h. p. motor. The pan feeder insures a continuous uniform feed, which is very essential for screening purposes. The 240 ft. x 20 in. inclined conveyor delivers all the material to the top of the washing plant. The water for washing is furnished by a direct connected Allis-Chalmers centrifugal, single stage, closed runner type pump, with a capacity of 600 gals. per minute.

The material is screened and washed through three conical screens 48 in. x 76 in. x 108 in. The first screen has perforations of 1¼ in., the rejects of this screen giving a product of 1¼ in. to 2½ in. The material which passes through this screen is washed into a second screen, which has perforations of ½ in. in diameter. The rejects from this screen give a product from ½ in.

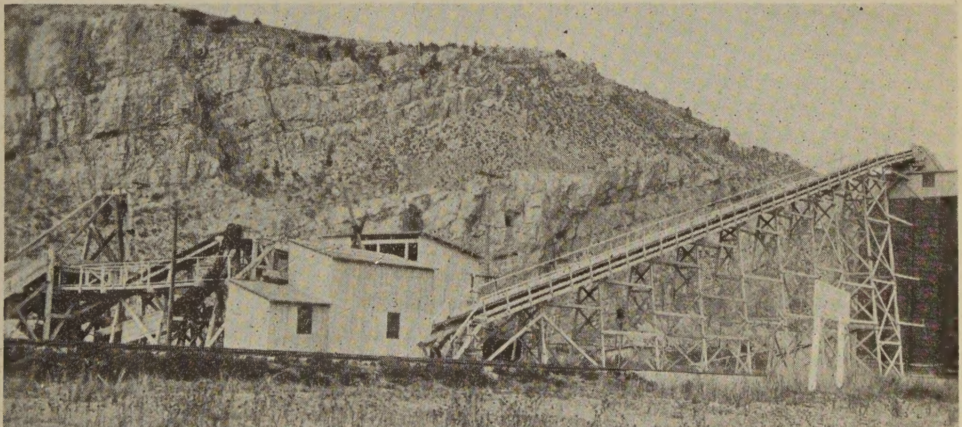

Fig. 1—240-ft. Center Belt Conveyor, Conveying the Product from Scalping Screen to Washing Plant

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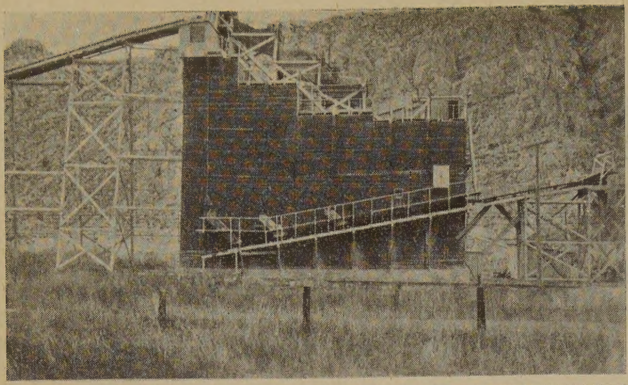
[1] Allis-Chalmers, Milwaukee, Wis.

[2] Stephens-Adamson Co., Aurora, Ill.

[3] Chalmers & Williams, Chicago Heights, Ill.



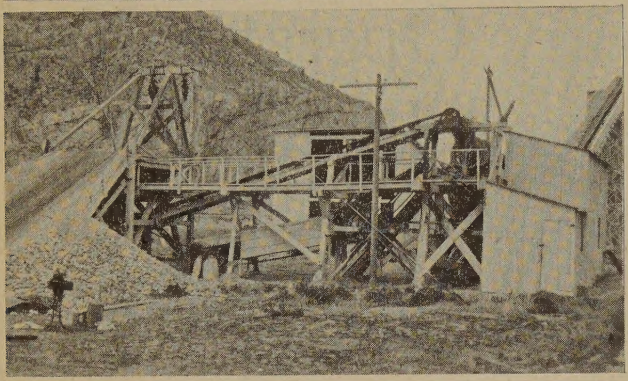
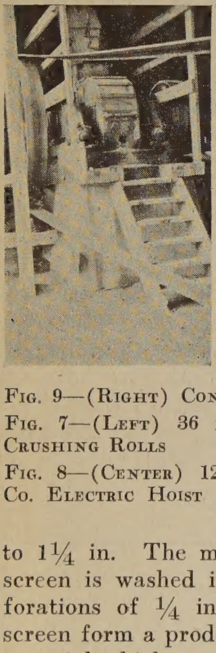
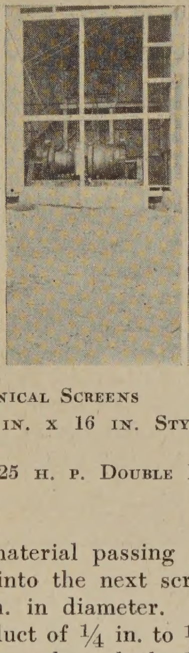


FIG. 2—(UPPER) WASHING PLANT, SHOWING CONICAL SCREENS, LOADING CONVEYOR, ETC.

FIG. 3—(LOWER) INCLINE AND RECEIVING HOPPER, WHERE DRAG BUCKET BRINGS IN GRAVEL





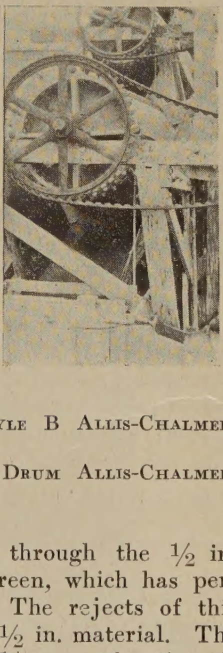
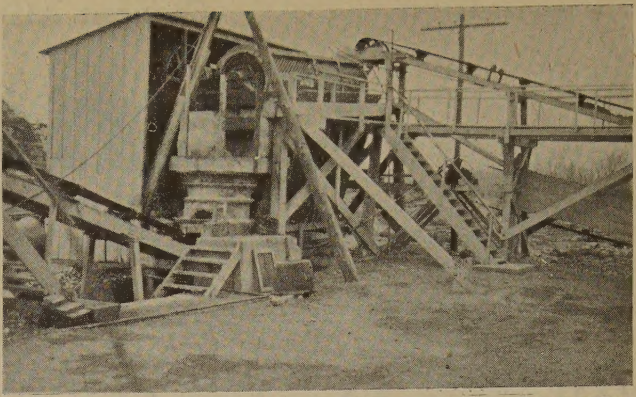


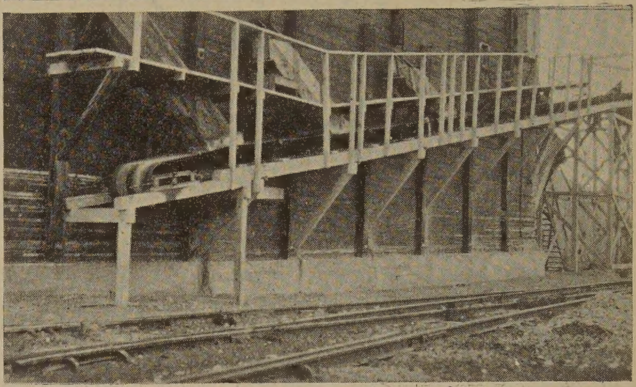
FIG. 9—(RIGHT) CONICAL SCREENS

FIG. 7—(LEFT) 36 IN. x 16 IN. STYLE B ALLIS-CHALMERS CRUSHING ROLLS

FIG. 8—(CENTER) 125 H. P. DOUBLE DRUM ALLIS-CHALMERS CO. ELECTRIC HOIST

to 1¼ in. The material passing through the ½ in. screen is washed into the next screen, which has perforations of ¼ in. in diameter. The rejects of this screen form a product of ¼ in. to ½ in. material. The material which passes through the ¼ in. perforations is washed into a sand washing machine, which consists of two parallel 16 in. x 12 ft. screw conveyors, one of which is right-hand and one left-hand, which are placed in a box on an incline of about 16 degrees. These conveyors revolve 20 revolutions per minute, and are constantly turning the sand and washing it. As the sand passes upward along the incline of the conveyors the water is eliminated and the sand is deposited into the sand bunker. The waste water is taken from the top of the water level in this box into a waste spout, which carries it back into the river. The entire washing plant is operated by a 50 h. p. motor. In order to avoid any back traveling of the aggregates, on the return side of the belt conveyors, a spray of water





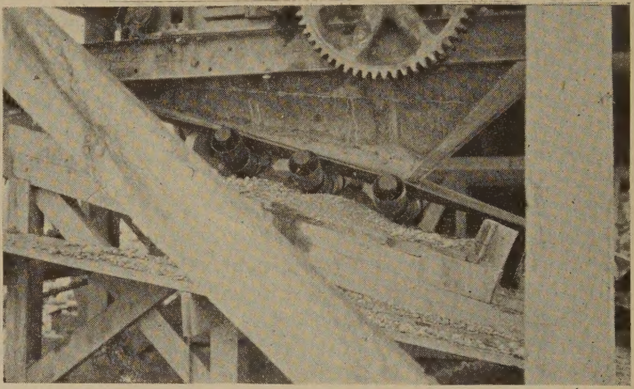
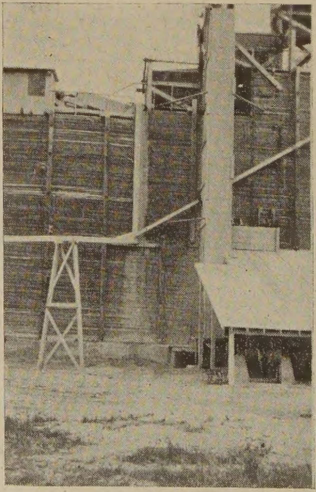


FIG. 4—(UPPER) SCALPING SCREEN AND NO. 5 B SYMONS GYRATORY CRUSHER

FIG. 5—(CENTER) LOADING CONVEYOR, SHOWING SPOUTS FROM BINS, WHERE ANY DESIRED MIXTURE CAN BE MADE BY ADJUSTING GATES

FIG. 6—(LOWER) STEPHENS-ADAMSON PAN FEEDER TO BELT CONVEYOR FROM RECEIVING HOPPER TO SCALPING SCREEN



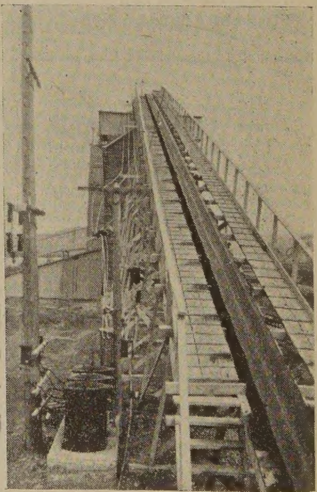


FIG. 10—(LEFT) ELEVATOR FROM ALLIS-CHALMERS ROLLS TO SCREEN IN WASHING PLANT

FIG. 11—(RIGHT) 240 FT. 20 IN. INCLINED BELT CONVEYOR

washes the belt just as it is leaving the head pulley.

If the accumulation of 1¼ in. x 2½ in. gravel should be in excess it is reduced by a No. 25 Kennedy gearless crusher[4] operated by a 25 h. p. motor. The product of this reduction is transferred to the washing plant by means of an inclined belt conveyor, then rewashed and screened. The material produced by this operation is then transferred by spouts from the bunkers to a 36 in. x 16 in. Style B Allis-Chalmers crushing rolls, operated by a 40 h. p. motor. By means of an elevator this product from the rolls is taken to the washing plant and washed through a ¼ in. perforation conical screen and sized accordingly.

The loading is accomplished with a 36-in. belt conveyor operated by a 10 h. p. motor. The material from any of the four bunkers can be fed to the belt or materials from all the bunkers can be fed to the belt at the same time. Thus any mixture required by the various customers can be easily obtained by governing the gate openings.

The loading and storage tracks are all on a 1% grade, thereby eliminating any cumbersome means of moving cars. A full crew for operating, loading and shipping consists of five men.

The plant was designed and constructed by the Three Forks Portland Cement Co.

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[4] Kennedy-Van Saun Mfg. Co. and Eng. Corp., 120 Broadway, New York City.

Increased Production Efficiency in the Industries

A symposium on "Increased Production Efficiency in the Industries" recently published in *Chemical and Metallurgical Engineering* as containing concise statements by leading representatives of the chemical and related industries in answer to the question, "What would contribute most to increased production efficiency in your industry," contains two articles of interest in our field.

The following articles, one by P. H. Bates, chief, Division of Ceramics, U. S. Bureau of Standards, dealing with the cement industry and the other by Warren E. Emley also of the Bureau of Standards on scientific control in the lime industry are abstracted from the symposium and tend to point out what are considered the weak spots in the industries concerned.

Need of Research in the Portland Cement Industry[1]

By P. H. Bates

Nothing has served to demonstrate to the portland cement industry the possibilities of increased production efficiency more than the results which have been obtained by the installation of properly designed waste-heat boilers and the power plant equipment required by such installation. Though it is true that some of the first to attempt the use of such waste-saving devices met with dismal failure, yet those who continued development along these lines, or the others who studied the first failures, have met with such success that now all concede the marked increase in plant efficiency obtained by the use of the waste heat recovered from the rotary kiln. If a plant with but three 150-ft. kilns can generate from the heat formerly wasted by these not only enough power to run the entire plant but sell an unrequired surplus, what more striking example of the possibilities in production efficiency could be desired?

What Is the Most Efficient Length of Kiln?

Such results have been obtained by the first intensive study of but one feature of plant equipment. There is reason to believe that the study of all the other features might produce as highly gratifying developments. Hence why not continue the study with the kiln and determine the most efficient length of kiln for any type of raw material and the proper ratio between length and diameter? Kilns now vary from 6 to 12 ft. in diameter, and from 60 to 240 ft. in length.

The settling, for the time being, of the fineness requirements in the standard specifications for cement is too recent to have dropped from the memory of many. The discussion of this will be recalled to have hinged upon the ability of certain of the common types of grinding mills to produce the fineness of product asked for by many and upon the cost of such extra grinding by any type of mill. It served to bring out strikingly the fact that the type of mill used was largely a matter of personal preference, without any basis of actual data of the efficiency of the various types used. Here again the question is not one of variety alone but also of size. What should be the ratio of length to diameter of tube mills, or what should be the diameter of the various types of ring mills for the greatest efficiency?

Research the Important Factor

There can be no doubt that the most important factor toward increasing production efficiency in the portland cement industry would be research, especially along the lines of operation of the mechanical plant and leading toward the standardization of plant equipment. This is suggested without even considering the need of research along chemical lines such as might lead to certain changes in composition or raw material as would reduce the clinkering temperature or the need for the usual degree of fineness of raw material. It is suggested also without regard to the desirability of research to determine whether portland cement as now made is of the proper composition for all purposes, or without regard to investigations which might lead toward such radical changes in production procedure as recently brought forward in France with the appearance of the "fused cements."

Mechanical research is the feature which can bring in the shortest time to this huge chemical industry—the manufacture of portland cement—the greatest increase in production efficiency. While it is to the credit of the chemists and chemical engineers that this industry has grown from nothing to a value of annual production of close to $225,000,000 in somewhat less than half a century, yet for this industry to gain the efficiency of production that will be demanded of it to bring it to the level of the other chemical industries, it will be necessary for the chemists and chemical engineers to see that research is directed along these lines.

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[1] Originally published by permission of the Director of the Bureau of Standards of the U. S. Department of Commerce.

Intelligent Scientific Control Essential to the Lime Industry

By Warren E. Emley

Control—intelligent control—is undoubtedly the answer to the question, What can the lime industry do to increase its production efficiency?

Ten years ago there were few limekilns making more than 3 lb. of lime per pound of coal. Today there are few making less than 5. Fuel efficiency doubled in 10 years! This is an achievement of which any industry might justly be proud.

This was accomplished because competent engineers made a careful study of kiln design, fuel combustion, heat distribution and temperature control. The facts which were discovered were put into practice. Pyrometers and chemists have come to be important factors in the operations of a lime plant.

While congratulations are in order, one should remember that the fuel ratio theoretically possible is about 14 lbs. of lime per pound of coal, so that there is still room for further improvement.

However, fuel efficiency is only one item of production efficiency. The sale of the product should be studied just as carefully as its manufacture has been, and should be subjected to the same degree of "intelligent control."

Years ago one used to hear statements like this: "The stone in my quarry is not so pure as that of my neighbor. I can't make as good lime as he can, but it is not my fault." The modern version of this story shows a radically different viewpoint: "My neighbor makes a good building lime, but he is getting only $6 a ton for it and he can operate only 8 months a year. My stone will not make good building lime, but it is much better than his for making bleach. I will sell it for that purpose, where they pay $9 a ton and the demand is steady throughout the year."

The modern lime manufacturer has discovered the fact that no lime can be called good or bad unless its use is considered. A lime which is excellent for one purpose may be unfit to use for some other purpose. For this reason it is necessary for the lime manufacturer to study the way in which his lime is used. It is only through a thorough knowledge of his customers' requirements that he will be able to make the best lime to meet those requirements.

The old idea was to make the "best" possible lime from the stone available, the definition of the word "best" being based on the opinion of the lime manufacturer. This lime was then sold for a variety of purposes, for only a few of which it was suitable. The modern idea is to let the customer define the word "best"; to study his individual needs, and change the process of manufacture in such a way as to produce the kind of lime best suited to meet those needs. This, of course, involves accurate and continuous control not only of the manufacturing process but also of the sales organization, to see that each particular kind of lime is used only for the purpose for which it is best adapted.

Intelligent control includes not only the control over the manufacturing process and of the sales but a far more important idea: the lime manufacturer must control his opinion of the quality of his lime, and make it subservient to the opinions of his customers.

Recovery of Radiated Heat From a Rotary Kiln

By R. E. B. Hall,

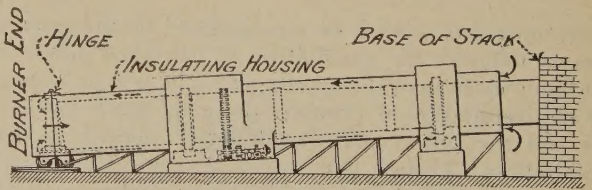
Advertising Dept. Johns-Manville, Inc.

Incident to the operation of a rotary cement kiln, a certain quantity of the heat supplied is wasted on the surrounding air by radiation from the kiln shell. This wasted heat is the source of two undesirable conditions. Of primary importance is the direct loss of an appreciable amount of fuel during the year due to the extra amount necessary to compensate for this radiation loss and still maintain the proper working temperature. In the second place, since most kilns are located within a building, the escape of this heat into the room makes working conditions trying and inevitably reduces the normal efficiency of the workers.

In an attempt to eliminate these disadvantages, insulation has been used between the brick lining of the kiln and the steel shell. This method has failed of being entirely successful since the effect of heat on the brick lining is a factor which must be considered where such high internal temperature as those of the kiln are to be met. The temperature of the brick obviously is increased if the heat loss from the brick is reduced. Consequently, although sufficient insulation should be used to save the maximum of heat possible, the temperature of the brick must not be permitted to reach the point which would reduce its life. Kiln linings last but a short time, at best, and any decrease of this time by such a mis-application of insulation is reason enough to condemn the method.

Seeking to recover this wasted heat, in their continual efforts towards fuel conservation, Johns-Manville, Inc., suggest a practical method which obviates the previously mentioned disadvantages without getting into further difficulties, and turns the radiated heat to use.

The kiln is to be surrounded by an insulated housing, consisting of an angle-iron frame built around the kiln and covered with insulating material. Air is drawn through this space from the open end of the housing at the base of the stack down to the burner end. The space is restricted so that the velocity of the air is high enough to carry away the radiated heat and thereby prevent an increase in the shell temperature. The air in this live-air space thus drawn into the kiln at the delivery end supplies the necessary air for the complete combustion of the fuel. Conditions are bettered when heated air is used in the place of cold air for combustion purposes since the fuel is not brought into contact with cold air which must be heated before combustion can take place. And with the radiated heat conserved, working conditions are correspondingly improved.



Kiln Inclosed in Insulating Housing

Losses by Radiation in Cement Kiln.

In developing this housing, Johns-Manville engineers made a study of the losses incurred through radiation. It was found that loss from the exposed surfaces of kilns often amounts to more than 1,000 b. t. u. per square foot of surface per hour. Assuming continuous operation for 300 days, or 7,200 hours per year, there is a loss through each square foot of radiating surface equivalent to the consumption of 600 pounds of coal per year.

As the heated air from a housing such as has been described can be utilized in combustion of fuel, or in other ways which we shall mention presently, so that about 90% of the radiated heat is recovered, the saving in fuel can be made to amount to about 540 pounds of coal yearly, per square foot of radiating surface.

An additional advantage is afforded by this housing by providing windows at any desired places along its sides to permit the condition of the shell to be observed while the kiln is in operation. The comparative darkness within the housing makes it easier to notice hot spots in the kiln shell than if the kiln were located in the open. Thus repairs may be made to the kiln lining where necessary before the steel shell itself has been damaged by the heat.

OTHER METHODS OF UTILIZING THE RECOVERED HEAT.

If for any reason it is not desired to use the heated air from the housing for purposes of combustion in the kiln, it may still serve profitably in a number of other ways. For example, the clay used in the manufacture of certain cements must be dried before use, and the drier can be heated with the recovered heat from the housing. This is particularly advantageous in a plant where the heated air for kiln combustion is obtained from the clinker cooler.

In other circumstances the air from the housing can be employed for heating purposes, or such other uses as suggest themselves from plant conditions.

This method of recovery of radiated heat, which, up to the present, has been developed with rotary cement kilns in view, could well be applied to other driers, either rotary or stationary, and also various types of industrial furnaces and kilns. In many of such applications the heat recovered would make an appreciable saving in fuel costs. And in all cases where the equipment which radiates heat is located within doors, general plant conditions could be improved by the reduction of the temperature in which it is necessary for the men to work.

The Utilization of Waste Heat From Rotary Cement Kilns

BY JOSEPH BROBSTON

The following is abstracted from a paper read before the Lehigh Valley Section of the American Society of Mechanical Engineers by Joseph Brobston, chairman of the Conservation Committee of the Portland Cement Association. It is not based upon original research work, but is a summary of the information available as to progress made up to the time the paper was prepared, most of the information having been collected by the committee.

The important conclusion is drawn that work on insulation of kilns, on the preheating of air going to the kilns, and on the use of stack gases, has progressed far enough to show that within the next five years there will be saved a total of 2,000,000 tons of coal annually, due to the utilization of waste heat, in the production of 100,000,000 bbls. of portland cement.

The sporadic efforts made to use the waste heat of rotary kilns prior to the sudden and material increase in the price of coal caused by the war, did not amount to more because of the very low price that the industry as a whole paid for its kiln coal. The coal generally used is the slack or screenings from three-fourths gas coal. This was formerly considered a waste product by the coal mines, and had to be moved when the three-fourths coal was shipped, which resulted in a price to the cement industry ranging from 20 to 75 cents a ton at the mines. The cost per barrel for burning cement was therefore comparatively low, and the efforts of the manufacturers were mainly directed to installing labor-saving machinery and reducing the cost of pulverizing the raw material and clinker.

THE FIRST MODERN WASTE-HEAT BOILER INSTALLED IN THE CEMENT INDUSTRY

When the price of coal jumped to $5 per ton at the mines, however, conditions were entirely different, and in 1915 the first modern waste-heat boiler plant in the cement industry was installed at the Catskill plant of the Alpha Portland Cement Co. This installation was a success from the start. The plant operates five kilns, three being 9 ft. in diameter by 120 ft. long, and the other two 7 ft. 6 in. in diameter and 120 ft. in length, resulting in an output of about 3,000 bbls. of cement per day. The gases from these kilns are drawn into a main or equalizing flue directly in the rear of the kiln housing or dust chamber, dampers being installed to by-pass gases into the kiln stacks, if necessary. Connections leading from the back of this flue conduct the gases to two 750 h. p. Edge-Moor boilers, of the four-pass type. Two Green fuel economizers, horizontal type, are installed after the boilers. The forced draft is provided by a fan located directly back of the economizers, driven by a Terry turbine. A steam pressure of 175 to 180 lbs. is maintained, and sufficient power is generated to operate the entire plant. The finely pulverized stone carried over from the kiln by the hot gases is blown from the boiler tubes three to four times in each 24 hours, a hand lance using 140 lbs. of air being employed for this purpose. The economizer tubes are blown off through plugged openings in the top of the casing several times each week. The clean-out doors at the bottom of each pass are opened once a week and the dust removed. Clean-out doors are also provided in the flues. In this way, if the draft at the stack chamber is not allowed to drop below 0.25 in. (water pressure), no real difficulty is experienced in keeping the installation free from dust. The temperature of the gases is reduced from approximately 1,400° Fahr. at the mouth of the kiln to about 450° when they leave the economizer. The Cochran feedwater heater is heated by the exhaust steam from the pumps and fan turbine. The operation of the boilers has not increased the amount of coal used per barrel in the kilns. It is about 95 lbs. per bbl. It requires not less than 40 lbs. of coal per bbl. to generate the power required to operate a cement mill. Deducting this from the 95 lbs. being used in the kiln, we find that today this company is burning its cement with 55 lbs. of coal, which is much closer to the theoretical amount required, that is, 30 lbs., than the cement manufacturers had ever hoped to come, and means that a rotary kiln with a waste-heat boiler attached is as economical in its coal consumption as the old-style upright kiln. Plants almost exactly duplicating the one described were promptly installed at another plant of the Alpha Portland Cement Co., and at the Dexter Portland Cement Co., and plants using B. & W. boilers were installed by the Universal and Louisville cement plants.

By this time all the manufacturers of portland cement were aware of the importance of this development, and the Conservation Committee of the Portland Cement Association, started an extensive investigation of the entire question. The first report presented in December, 1918, showed eight plants in operation. Today there are 24 plants in operation generating with their flue gases from 51% to 140% of the power they require. There are about 120 operating portland cement plants in the United States, so that 20% of the plants are now making use of their stack gases, saving on the average 40 lbs. of coal for every barrel made. This means that these companies are actually using about 400,000 tons of coal less per year than they did formerly.

It may be noted that in some cases more steam than is required to operate the entire cement plant is generated by the waste-heat installation. In other cases only a little over one-half of the amount required is secured.

While this is to a certain extent a question of the efficiency of the boiler installation, it may be due to other causes. The plant that is burning cement with 80 lbs. of coal to the barrel, will not have the volume of stack gases or temperature that will be found at the plant using over 100 lbs. to the barrel, so that naturally not as much steam can be generated. The total amount of coal used per barrel, however, may be lower at the plant using the 80 lbs., as it may be possible to generate the additional power required in auxiliary boilers with less than the extra 25 or 30 lbs. of coal consumed in the kiln.

But even when two waste-heat plants generate the same amount of steam, there may be a great difference in the percentage of the machinery that can be run with it. Where the amount of steam secured is just sufficient to operate a mill in which the prime movers are well-designed modern turbines, it would probably be only 75% of the steam required to operate another plant which is still being run with old-style inefficient reciprocating engines.

Power Required to Grind a Barrel of Cement

Where the prime movers are identical, there might still be a wide difference in the percentage shown. Recent investigations made by the Conservation Committee of the Portland Cement Association show that the power required to produce a barrel of cement at plants using different types of grinding machinery varies from about 13 kw. hours per barrel to about 19 kw. hours.

Some progress has also been made in the last three or four years in solving two other problems. The loss through radiation is being materially reduced by putting between the shell and the firebrick lining in the upper part of the kiln, a brick cut from diatomaceous earth. While it has not been possible to determine the exact amount saved in this way, it has been shown conclusively that where waste-heat boilers are being used this insulation raises the temperature of the flue gases 150°, and where boilers are not installed the insulated kilns require from 5 to 10 lbs. per barrel less coal to burn clinker than those not insulated.

This problem is not as yet fully solved, however, as it has been found impossible to use the insulating brick in the hottest section of the kiln, known as the burning zone. Here the fluxing action of the clinker at the high temperature necessarily maintained was such that the firebrick were practically destroyed in from 16 hours to four days. The hot zone can undoubtedly be insulated by using carborundum, but at the present time the cost of doing this would be prohibitive.

The Technical Problems and Conservation Committee of the Portland Cement Association are working on this problem with the firebrick manufacturers, and it is hoped that a suitable block that will stand up and which can be made at a reasonable price, will be developed.

Possibility of Reclaiming Heat Carried Off by Clinker

As to the possibility of reclaiming the heat carried off by the clinker, the development of the rotary pressure cooler in the last few years has demonstrated that where the cooler is of sufficient size and proper design to handle the kiln output it is possible to heat the air entering the kiln to a temperature of 800° to 900° Fahr. and to have enough heat left over to dry the coal used for kiln operation. How much this saves is problematical. So far the power required to operate the system has been found to be so great that there appears to be very little actual saving.

In the ideal cement plant of the future there should be no wasted heat. Where the engine room is equipped with the modern economical type of prime mover, and the mill has been designed and equipped with grinding machinery that requires the minimum amount of power, the stack gases will generate not only sufficient steam to run the plant and heat the buildings, but there will be enough left over to dry the stone. All the heat will be drawn from the clinker and it will be sufficient to raise the temperature of the air required to support combustion in the kilns to a point that will materially reduce the amount of coal needed for burning, and there will be enough left over to dry the coal before it is pulverized.

With the preheating of the air and the insulating of the balance of the kiln, the amount of coal required to burn should certainly not be over 75 lbs. to the barrel. Deducting from this the 40 lbs. required for power, the 3 lbs. required for drying the stone, and 1 lb. each for drying the coal and heating the buildings, the theoretical figure of coal required to burn a barrel of cement is reached, namely, 30 lbs. per barrel.

While this ideal may never actually be attained, the work on all three problems has progressed far enough to show that within the next five years, through the insulation of kilns, the preheating of the air going to the kilns, and the use of stack gases, there will be saved in producing 100,000,000 bbls. of portland cement, besides the 400,000 tons already mentioned, about 1,6000,000 tons, or a total of 2,000,000 tons due to the utilization of waste heat in the industry.

Repairing a Wood Crusher Building

By E. G. Baker

The name of this periodical Concrete indicates that it stands for permanence and stability in construction work. It would seem a little incongruous, therefore, to give much space to a wood structure. In detailing some of the troubles the Ohio Hydrate & Supply Co. has had with its crusher building, the writer hopes it will serve as a warning to those contemplating building to keep away from such construction, but having such a building on hand, and obliged to make the best of a bad situation, was the condition that confronted us.

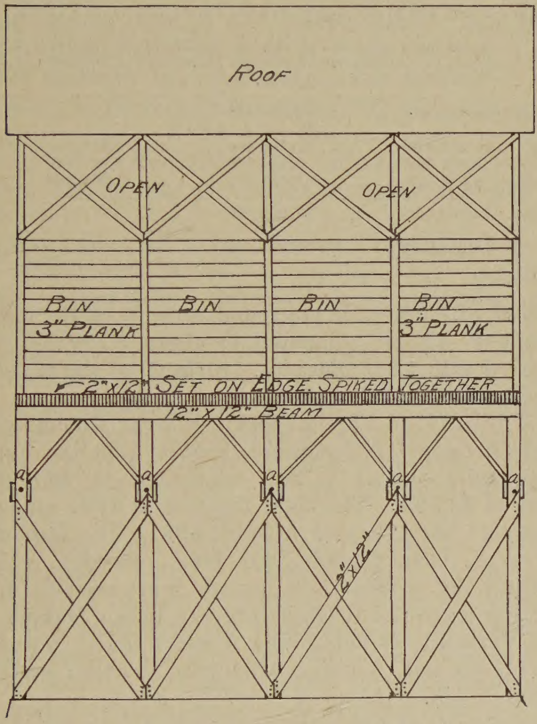


Fig. 1—Sketch Showing Type of Crusher Building

The building shown in the sketch (Fig. 1) is of wood (pine) and about five years old. It contains four bins each 10 ft. x 20 ft. and 12 ft. high. It is supported by 10 pine posts, 12 in. x 12 in., 21 ft. high, set on a good concrete foundation. These posts support 12 in. x 12 in. pine beams 40 ft. long, running on either side of the building. Upon these beams 12 in. plank 2 in. thick and 20 ft. long are set edgewise and spiked together, forming the floor of the bins. From this floor 6 in. x 8 in. posts extend to the plates supporting the roof.

The sides and partitions are made of 3 in. plank, and the bins were designed to draw the stone through a spout in the center of each bin, the material forming its own hoppers.

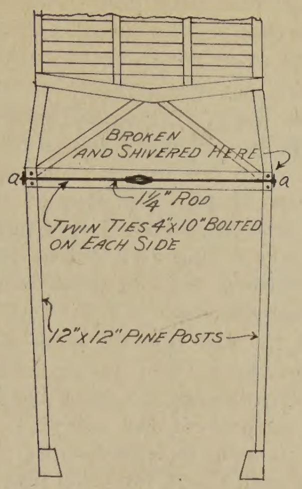


Fig. 2—Sketch Showing Slope Resulting from Sagging Floor

About 5 ft. from the top of each of the main posts, mortises were cut on three sides to admit 6 in. x 8 in. braces, running to the 12 in. x 12 in. beam and to the middle of the building, as shown in Fig. 2. The effect of these three mortises was to cut the post about one-half off at this point and very materially weaken it. As the building filled with stone, the middle of the plank floor sagged and these heavy interior braces thrusting outward pushed the posts out of perpendicular and made it assume the shape shown.

To prevent the posts from breaking off by this outward thrust, 1¼-in. iron rods, with turn buckles, were installed at *a a* and heavy twin ties 4 in. x 10 in. were bolted to the sides of the posts.

By this means further spreading was prevented, but the building looked like a bow-legged man, and the wood at this point was splintered and slivered and water from driving rains entered the mortises and decay gradually set in.

This happened about two years ago.

The next thing that happened was a gradual spreading and pulling apart of the plank floor at the ends by reason of the weight of the stone bulging out the ends. This finally became so bad as to cause fears that the entire end of the crusher building would give way and precipitate the stone on the track 20 ft. below.

To prevent this we went into the woods, cut and peeled two rock elm poles about 22 ft. long and 12 in. in diameter at the top end, flattened each on one side with a broad axe, and trussed it by placing at the middle a 6 in. x 8 in. piece of oak 18 in. long and passing a 1¼-in. round iron rod with an eye in each end over the end of the 18-in. oak piece in the middle of the timber.

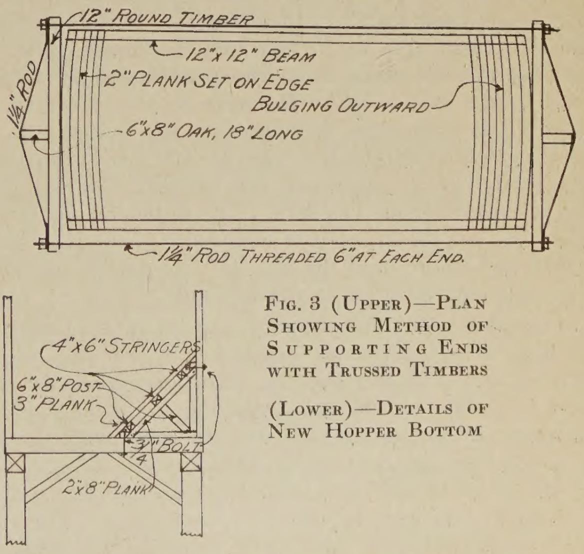


Fig. 3 (Upper)—Plan Showing Method of Supporting Ends with Trussed Timbers

(Lower)—Details of New Hopper Bottom

The next calamity was that the heavy pine posts, cut partly off by mortises and broken by the outward thrust of the heavy braces, began to shear off and settle down.

The only remedy for this was to go again to the woods, get out trees which we cut 21 ft. long and peeled, jack up the bins, take out the broken posts and in their stead place the round trees where the braces came, saw the tenons from the braces and spike the foot of the braces firmly to the sound post, flattened at this point to receive the brace. This was a long and tedious job, but was successfully accomplished, the old posts being removed and the new ones substituted.

It was found that, due to the fact that the stone and screenings were wet, the pine floor (2-in. plank set on edge) was badly decayed. To prevent the stone breaking through the floor, and to prevent the carrying of about 100 tons of material to form its own hopper, we took railroad ties 6 in. x 8 in. and $7\frac{1}{2}$ ft. long and placed the ends together at right angles. Across the ends we spiked 2-in. x 8-in. plank and inserted a center piece of oak in the right angle formed by these two ties. We placed three of these timber brackets on each side of a 10-ft. bin, and across the brackets ran three 4 in. x 6 in. stringers, as shown in Fig. 4. On these stringers were spiked 3-in. plank up and down, this forming hoppers and leaving the space, formerly taken up by stone, vacant so that air can circulate through and thus prevent further decay.

The crusher building seems to be in the best shape it has been since it was constructed, and we expect with the various repairs we have made that it will be good for two more years of service, when we expect to build a new concrete and steel crusher building that will eliminate troubles of the kind we have been having.

Cement on Free List

By Irvin D. Foos

Roman, portland and other hydraulic cement are on the free list under the new tariff law. The duty of 5c per 100 lbs. in packages, 4c per 100 lbs. in bulk, and a duty of 17% American value on other cement not specially provided for, imposed by the bill as it passed the House, were stricken out in conference. Roman, portland and other hydraulic cement went back to the free list, and a duty of 20% foreign value was placed on other cement not specially provided for. Crude gypsum also was transferred to the free list, the House conferees receding in conference from the proposed duty of 25c a ton in the House bill. The rate on crude magnesite was fixed in conference at 5/16c per lb.; $\frac{5}{8}$c per lb. on caustic calcined magnesite; and 23/40c per lb. on dead-burned and grain magnesite not suitable for manufacture into oxychloride cements. The duties in the House bill of $\frac{3}{4}$c per lb. on calcined magnesite (including dead-burned and grain) and the duty of $\frac{1}{2}$c per lb. on crude or ground magnesite were stricken out.

Limestone, (not suitable for use as monumental or building stone) crude or crushed but not pulverized, bears a duty of 5c per 100 lbs.; lime, not specially provided for, 10c per 100 lbs., including the weight of the container; and hydrated lime, 12c per 100 lbs., including the weight of the container. These rates, contained in the bill as it passed the House, remained unchanged by the Senate, and were approved in conference. The conference committee on the tariff reported the changes mentioned above on September 12.

Portland Cement in August

The statistics shown in the following table, prepared under the direction of G. F. Loughlin, of the United States Geological Survey, are based mainly on reports of producers of portland cement, but in part on estimates. The use of estimates was made necessary by the lack of returns from two producers.

PRODUCTION, SHIPMENTS, AND STOCKS OF FINISHED PORTLAND CEMENT IN AUGUST, 1922, AND PRECEDING MONTHS

Month	Production (bbls.)		Shipments (bbls.)		Stocks at end of month (bbls.)	
	1921	1922	1921	1922	1921	1922
January	4,098,000	a4,291,000	2,539,000	a2,931,000	10,300,000	a13,316,000
February	4,379,000	4,278,000	3,331,000	3,285,000	11,400,000	a14,142,000
March	6,763,000	6,685,000	6,221,000	7,002,000	12,000,000	a13,848,000
1st quar.	15,240,000	15,254,000	12,091,000	13,218,000	....	....
April	8,651,000	9,243,000	7,919,000	8,592,000	12,600,000	a14,470,000
May	9,281,000	11,176,000	9,488,000	12,749,000	12,450,000	a12,893,000
June	9,296,000	11,245,000	10,577,000	13,470,000	11,150,000	a10,718,000
2nd quar.	27,228,000	31,664,000	27,984,000	34,811,000	....	....
July	9,568,000	11,557,000	10,301,000	13,850,000	10,414,000	a 8,433,000
August	10,244,000	11,664,000	12,340,000	14,361,000	8,280,000	5,737,000
Sept.	10,027,000	....	11,329,000	....	6,953,000	....
3rd quar.	29,839,000	....	33,970,000	....	....	....
October	10,506,000	....	12,114,000	....	5,348,000	....
November	8,921,000	....	5,195,000	....	9,091,000	....
December	6,559,000	....	3,697,000	....	11,938,000	....
4th quar.	25,986,000	....	21,006,000	....	....	....
	98,293,000	....	95,051,000	....	....	....

a Revised.

Stocks of clinker, or unground cement, at the mills at the end of August amounted to about 2,760,000 bbls., compared with 4,833,000 bbls. (revised) at the beginning of the month.

The Bureau of Foreign and Domestic Commerce, of the Department of Commerce, reports that the imports of hydraulic cement in July amounted to 958 bbls., valued at $3,995. The total imports in 1921 amounted to 122,317 bbls., valued at $388,828. The imports in July were, from Canada, 951 bbls.; Sweden, 4 bbls., and Germany, 3 bbls. The imports were received in the following districts: Washington, 718 bbls.; Dakota, 186 bbls.; Vermont, 37 bbls.; New York, 7 bbls.; Maine and New Hampshire, 5 bbls.; Michigan, 4 bbls.; and New Orleans, 1 bbl.

The exports of hydraulic cement in July were 119,491 bbls., valued at $342,037; of this total, 117,137 bbls., valued at $327,075, was portland cement, which was sent to South America, 46,354 bbls.; to Cuba, 40,628 bbls.; to the other West Indies, 6,368 bbls.; to Central America, 13,205 bbls.; Mexico, 7,455 bbls.; Canada, 1,056 bbls.; and to other countries, 2,071 bbls. The total exports of hydraulic cement in 1921 were 1,181,014 bbls., valued at $4,276,986.

The statistics of imports and exports of hydraulic cement in August are not available.

IMPORTS AND EXPORTS OF HYDRAULIC CEMENT IN JULY, 1922, AND PRECEDING MONTHS a

Month	Imports (bbls.)		Exports (bbls.)	
	1921	1922	1921	1922
January	14,678	17,036	225,561	70,725
February	18,269	5,157	84,230	82,421
March	7,631	1,597	97,302	103,556
April	1,540	10,855	93,009	75,412
May	2,035	2,521	82,409	100,068
June	1,657	14,179	100,831	96,263
July	3,455	958	81,091	119,491
August	10,988	(b)	84,538	(b)
September	5,177	.....	84,668	......
October	11,448	.....	79,871	......
November	20,112	.....	71,214	......
December	25,327	.....	96,290	......
	122,317	.....	1,181,014	......

a Compiled from records of the Bureau of Foreign and Domestic Commerce.
b Imports and exports in August, 1922, are not available.

Storage and Transportation of Portland Cement[1]

With a Bibliography

By W. M. Myers.

Assistant Mineral Technologist, U. S. Bureau of Mines

The U. S. Bureau of Mines conducted an investigation to determine the cause of the deterioration of portland cement during storage and transportation, and to discover a means of preventing it. All available printed sources of information on this subject have been examined and a bibliography has been compiled. The subject has also been discussed with the leaders in the cement industry; the present report is the result of their cooperation, and is based principally on information thus obtained.

Deterioration of portland cement during storage over any considerable period of time has long been noted; closely related to it is the deterioration of cement during transportation, which involves not only the time factor of storage but also exposure to varied climatic conditions. Deterioration in both cases is due to hydration of the cement by absorption of moisture from a humid atmosphere, or by exposure to actual rain-fall. After hydration cement possesses no cohesive power; the degree of deterioration is directly proportional to the degree of hydration.

The amount of deterioration of portland cement during storage has been accurately determined in an investigation by the Structural Materials Research Laboratory, in co-operation with the Portland Cement Association. Cement stored in a shed in cloth sacks retained 80 per cent of its original strength after three months storage; 71 per cent after six months; 61 per cent after one year; and 40 per cent after two years.

The deterioration of portland cement during storage and transportation was noted particularly in France during the World War. Information concerning cement used by the American Expeditionary Forces was furnished by Lt. Col. H. S. Spackman and Major E. C. Eckel, U. S. R., who had charge of practically all matters concerning cement used by the A. E. F.

The cement used by the A. E. F. came from the following sources: 42,000 tons was French, Swiss, and Spanish cements; 120,000 tons was English cement; 55,000 tons made in plants operated by the A. E. F.; 500 tons (Not over) from America. Deterioration was most marked in cement from the first source.

The climatic conditions in France are very severe for finished portland cement, owing to the long rainy season and the accompanying high humidity. Cement stored for a period of two months was sometimes almost worthless. Cement was not always stored where it could be reached easily, and some storehouses were emptied in the reverse order of filling, so that the material stored first was the last to be removed; some cement, therefore, was unavoidably stored longer than it could withstand the climate.

The deleterious effect of the climate of France on portland cement is constant. It is not dependent on unusual conditions, as is recognized by French manufacturers, who endeavor to send their product direct to the point of consumption immediately after grinding. The specifications of the French Government for storage of cement are strict, as may be seen from the following résumé:

1. Cement must be stored in an air-tight room.
2. Cement must be covered with tarpaulin.
3. Cement must not be stored nearer than 18 inches to the wall.

Some English cement used in France was damaged further as a result of the English custom of shipping it in 200-pound bags; these heavy bags are difficult to handle, and are torn by the hooks of the stevedores, thus exposing the cement directly to atmospheric conditions.

The quality of the little American cement used was satisfactory.

In the United States, portland cement is shipped in barrels, in cloth or paper bags, or in bulk in cars. Cement for export is generally packed in barrels. The superiority of American packing over European barreled cements has been noted by commercial agents of the United States in South America.

The use of air-tight containers for storing and shipping portland cement would obviously prevent deterioration, but the prohibitive cost of such containers would greatly outweigh the benefits derived from their use. Two feasible improvements have been suggested that would not only improve the quality of the cement, but would also effect appreciable economy in transportation: (1) Storage and transportation of the cement in bulk; (2) storage and transportation of the cement in the form of unground clinker, and grinding the clinker at destination.

Storage and Transportation of Portland Cement in Bulk.

Deterioration of cement stored in bulk is less than in bags, owing to the smaller area exposed. Hydration takes place only at the exposed surface, and the bulk of the cement is unaffected. Cement transported in bulk must be shipped in a tight, closed car, and must be protected from moisture during loading, shipping, and unloading, preferably it should be used immediately after unloading at the point of destination. This practice is now followed by several manufacturers and where conditions are suitable it is becoming more common as its advantages are seen. Shipping in bulk effects a saving by eliminating the use of bags—which is an important item in the cost of cement and it should also permit a saving in freight rates.

Storage and Transportation as Unground Clinker.

Clinker, the fused product of the cement kiln before it is ground to form the finished portland cement, is exceptionally well adapted for transportation or storage over long periods of time under adverse conditions. It is extremely inert, and has no tendency to absorb moisture. Experiments show that clinker may be stored under water, or subjected to alternate dry and wet storage, without lowering the quality of the finished cement.

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[1] Reports of Investigations Bureau of Mines—Department of the Interior.

This cement has two distinct advantages: The quality of the cement produced from stored clinker is higher, and the grinding cost of the clinker is decreased because of mechanical disintegration.

The improvement in the quality of cement made from stored clinker is due to the hydration of any free lime (CaO) that may be present. Free lime is injurious to the finished cement, as it produces unsoundness. It is not present in a perfectly burned clinker, but it is present occasionally as a result of imperfect mixing of raw materials and of careless manipulation. Cement manufacturers, therefore, generally store clinker for several weeks or months before grinding. Clinker that produced unsound cement in one instance was found to yield a satisfactory product after being treated with steam to hydrate the free lime.

Though portland cement in the form of clinker is most carelessly handled and stored without regard to humidity or climatic conditions, yet improvement rather than deterioration of quality is manifest in the ground product.

The mechanical disintegration of clinker during storage makes grinding easier, thus somewhat increasing the capacity of the mills and decreasing the cost.

Decrease in Shipping Costs

Clinker, like iron ore, can be handled in bulk in large quantities. Barges or steamers can be loaded cheaply and the heavy expense of using bags for the finished portland cement may be entirely eliminated. Freight rates on clinker shipped in bulk should be lower than the rate for bagged cement, hence an appreciable saving could probably be made on this item. It would not, of course, be practical to ship clinker short distances to points near the source, as all demands for cement could be supplied from the manufacturer, the elements of transportation and storage being unimportant.

Operation of a Plant to Grind Clinker

The feasibility of operating a grinding plant in connection with any cement project depends on several factors, of which the following are the most important:

1. The cost of erecting the plant. This cost would vary according to the location, and with the cost and transportation of machinery and supplies.
2. Operating cost of plant, depending among other things, on the amount and type of power and labor available.
3. Loss in possible subsequent scrapping of plant.
4. Amount of cement used and possibility of continued demand.
5. Economies to be realized in transporting clinker to mill, as against loss in material by transporting the ground cement.
6. Difference in freight transportation for clinker and for finished cement.
7. Saving by eliminating the use of bags.

The actual expense of installing a grinding plant would probably not be less than $10,000 under the most favorable circumstances, so that it would be impracticable to grind clinker for any project using less than 30,000 or 40,000 bbls. of cement.

The transportation of portland cement in the form of clinker could be applied to any large construction project situated at a distance from the nearest cement mill in the United States; it could be applied also to a foreign market. To warrant the installation of a grinding plant in such a market, it would be necessary that the market should be located favorably with regard to cheap transportation; that it be a large consuming or distributing point; and that there be no competition from local manufacturers. Exceptionally humid climate, or other conditions injurious to finished portland cement, would be an added inducement. In a number of South American ports these conditions exist. One cement manufacturer 12 years ago made extensive plans to ship clinker to Cuba and grind it there, but apparently did not attempt to carry out his plans.

A prominent engineering company of New York is now engaged in a large construction project in Brazil, and is installing a clinker mill at Ceara, composed of two units having a capacity of 500 bbls. per day. It is planned to ship portland cement in the form of clinker and grind it at destination. The results obtained will be of great value, not only as to the relative costs of shipping bag cement as against clinker, as to other economies involved, but also as to the general feasibility of the whole project.

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South Dakota to Proceed With Plant

At a recent meeting of members of the South Dakota State Cement Commission at the La Salle Hotel in Chicago, Ill., a contract was entered into between the commission and the J. C. Buckbee Co., engineers, Chicago, to take charge of the engineering work in connection with the construction of the proposed portland cement plant for the State of South Dakota.

A site near Rapid City has been selected, and it is expected that work will be started immediately. Rapid City was selected as the location for the mill because it lies in the center of the limestone field, and in the foothills of the Black Hills, providing means of gravity conveyance.

The state has no intention of interfering in the field of individual enterprise, according to Secretary Hunt, of the commission, but plans to lead the way in development of South Dakota's resources for cement manufacture, which private enterprise has not yet seen fit to undertake.

The issuance of $2,000,000 public obligation bonds by the state, Mr. Hunt explained, was intended for the development of state resources as well as improvements.

Phoenix Company to Expand in South

The Phoenix Portland Cement Co., of Nazareth, Pa., has purchased 80 acres of land near Birmingham, Ala., and has commenced the erection of what will probably be the largest cement plant in the south, at a cost of $2,500,000, and with a capacity of 1,500,000 barrels annually. Ample allowances are being made in the design of the plant for increasing the capacity as soon as market conditions warrant it.

Formal announcement of the location of the new cement plant was recently made by Lindley C. Morton, president of the company, who stated that the construction work of the plant would be rushed, and that it was hoped to have the plant in operation by May, 1923.

The site of the new cement plant is an ideal one. The land was purchased from the Sloss-Sheffield Iron and Steel Co., and is contiguous to the by-products plant of that company.

R. J. Hawn will have charge of the construction of the new cement plant. He will also be in charge of the plant when completed. E. P. Haubert, secretary and purchasing agent for the company will spend a considerable amount of his time in Birmingham while the plant is under construction. R. S. Scott, consulting engineer, is making the power lay-out. The buildings will be constructed of steel and concrete throughout. The plant will contain many new features of design that have never before been incorporated in a cement plant, and should be the most efficient and up-to-date plant of its kind in this country.

President Morton stated that the use of diamond drills on the property had disclosed deposits of limestone of high quality, sufficient for the manufacture of 200,000,000 barrels of the best portland cement.

The company has already let the following contracts: converters, to the Worthington Pump and Machinery Co.; dryers and kilns to the Vulcan Iron Works, Wilkes-barre, Pa.; tube mills to the Traylor Engineering and Manufacturing Co., Allentown, Pa.; electrical equipment to the General Electric Co.; locomotive cranes to the Orton and Steinbrenner Co., Huntingdon, Ind.; traveling cranes to the Champion Engineering Co., Kenton, Ohio; Bradley Hercules mills to the Bradley Pulverizer Co., Allentown, Pa. Other contracts remain to be let and all of the material is yet to be bought.

In discussing the location of the plant at Birmingham, President Morton stated that for some time the splendid possibilities in the south have strongly appealed to his company, and, about a year ago, the company's engineering department was started on a search to locate the best possible southern site for a modern plant for the manufacture of portland cement.

After looking over some twenty deposits of raw materials and plant sites in three different southern states, what is considered the most ideal site in the United States was finally located in the heart of the Birmingham district.

The plant will be served by all of the seven railroads in the Birmingham district either direct or through the Mary Lee Railroad and the Birmingham Belt Railroad. This should insure the very best transportation facilities to all parts of the South, as the company expects to serve all of the Southern territory between the Atlantic seabord and the Mississippi River.

As the Birmingham district and Alabama already have a number of large cement mills, the location of this plant will make the Birmingham district one of the most important cement manufacturing centers of the south.

Security Cement & Lime Co. Expands

The Security Cement & Lime Co., Hagerstown, Md., is increasing its capacity and output 50% to meet the increase which has taken place in this company's business within the last few years. Less than a year ago a new stock house having a capacity of over 100,000 bbls. of cement was built in order to take care of the mid-summer peak demand.

Present expansion will include a large stone storage, new haulage system between quarry and mill, necessary additions to conveying, drying and grinding equipment, a 50% increase in kiln capacity and corresponding increases in capacity of coal mill and finishing mill.

The work has already been started under the direction of E. S. Guth, superintendent, who will also act as chief engineer in charge of construction. Plans are in charge of J. B. Ferguson Engineering Co. and the purchase of the equipment will be handled by A. M. Tyree, secretary-treasurer and purchasing agent.

Orders have been placed for practically all of the necessary equipment and work is now actively under way at the plant. The company expects to have this increased capacity in operation early next spring.

German Cement Supreme in Brazil

German cement imported by Brazil again has wrested predominance in this trade from the United States, although the quality of German cement is not equal to that of the American product. In this fight for trade Germany was aided by her depreciated currency, which permitted her to quote prices much below those of her competitors. The quantities furnished to Brazil by the principal exporting countries last year were as follows: Germany, 82,555 metric tons; United Kingdom, 22,536; Denmark, 16,626; Belgium, 11,290; Italy, 10,410; United States, 8,005; France, 2,047. It will be noted that imports from the United States dropped practically to the bottom, after occupying first place in 1918, 1919, and 1920.

Total imports of cement into Brazil in recent years were as follows, as shown from reports prepared by the office of Commercial Statistics of the Brazilian Government:

Year	Quantity Metric Tons	Value Contos of Reis	Value In Dollars
1921	156,872	26:239$	$3,503,009
1920	172,992	26:624$	5,627,154
1919	198,418	35:342$	9,261,530
1918	51,715	10:586$	2,682,037
1913	465,314	22:003$	7,077,263

In 1913 Germany supplied 188,806 metric tons of the total imports; United Kingdom, 130,367; Belgium, 60,216; United States, 50,624; Austria-Hungary, 10,323; France, 9,7443; Denmark, 7,317; Sweden, 4,560. There was a considerable decline in this trade during the war and a practical cessation of imports from European countries. In 1918, of a total of 51,715 tons imported, the United States furnished 37,903 tons and the United Kingdom 8,139.

After the armistice the resumption of construction work brought a revival. In 1919 imports of cement from the United States totaled 106,389 tons of the total imports of 198,418 tons, while Great Britain supplied 54,137 and Sweden 22,810 tons. During 1920 the United States sent to Brazil 76,129 tons; the United Kingdom, 47,794 tons; Belgium, 14,005; Germany, 13,826; Italy, 8,128, and Sweden, 7,240. Germany came back into her prewar pre-eminence the following year.

British Standard Specification for Portland Cement

The present edition of the British Standard Specification for Portland Cement was issued some two years ago, and sufficient time has elapsed to enable it to be discussed in the light of experience.

It may be taken for granted that, apart from the value of standardization, the prime object of a specification is to ensure that the buyer obtains the material he needs, and this in the case of portland cement may be defined as a material with (*a*) reasonable setting properties, that is, properties which give sufficient time for mixing and deposition before setting commences, (*b*) satisfactory hardening qualities, implying early development of strength as well as great ultimate strength, and (*c*) stability, or freedom from expansion and disintegration.

So far as setting properties are concerned, the present specification is adequate, requiring as it does that the initial set shall be not less than 20 minutes and the final set not more than 10 hours. The method of testing is, however, open to criticism as having an arbitrary and unscientific basis. The initial set, being the time when a needle of certain dimensions and weight fails to penetrate a block of cement mixed under certain defined conditions, merely indicates that the cement has attained a certain degree of stiffness, and does not necessarily indicate the commencement of the chemical action of setting. There is, indeed, good reason to believe that setting actually commences in many cements some considerable time before the initial set is recorded, and hence it is always advisable that concrete should be placed in its final position as soon as possible after mixing.

There is no doubt that the question of determining the setting time of cement has exercised the standardization committees of many nations, but apparently an arbitrary basis, similar in principle to that in the British Standard Specification, is universal. Probably the most scientific basis in the present state of knowledge would be the rise in temperature of the cement when mixed with water, the initial set being the period elapsing before a pronounced rise in temperature occurs. It is reasonable to assume that rise in temperature synchronises with commencement of setting. For accuracy, it might be necessary to conduct a test of this nature in somewhat elaborate apparatus designed to keep the test piece under conditions of insulation so that it be unaffected by fluctuations in atmospheric temperature, and that the heat generated during setting be not dissipated.

While a more scientific test for setting time would be welcome, the present test, as already stated, is adequate and safeguards the buyer from a cement which begins to set too quickly, or which takes an inordinate time to reach a certain degree of hardness.

Hardening qualities, which form the second fundamental property of cement, are now determined by the tensile strength of the cement at seven and twenty-eight days, both neat and when mixed with three parts of the standard sand. The first question that arises is whether neat tests are of any value, and it should be noted that neat tests are absent from the cement specifications of America and the more important European nations. The argument against neat tests is that they have no practical application, as cement is almost invariably mixed with sand and aggregate. The same argument might, however, be used with equal force against the sand tensile test, because as now defined, this test is far from being akin to practical usage, the proportion of cement being insufficient to fill the voids in the sand and the latter being ungraded. It will be seen that the real question at issue is whether the cement specification should be designed to show what strength may be obtained in practice, or whether it should have, for its foundation, tests based on the knowledge of what may be expected from a properly manufactured cement. The writer would be sorry to see the neat test disappear, because it reveals certain of the qualities of cement which cannot be seen in the sand tests; moreover, it should be realized that in a concrete the particles of sand and stone are often separated by masses of neat cement of appreciable thickness, and the strength of the concrete depends not only upon the adhesive qualities of the cement, but upon its cohesive properties, which are exemplified by the neat tests. It may be urged, then, that neat tests of cement are useful not only as an indication of the care with which the cement has been manufactured, but for the purpose of showing the cohesive powers of the cement, which powers are exercised in the practical application of the cement.

There is, however, one factor in the neat tests requiring consideration, namely, the 28 days' test. This test is a legacy from the early days of cement manufacture, when no satisfactory soundness test existed and consequently engineers deemed it necessary to impose a 28 days' test with a minimum increase over the 7 days' test in order to obtain evidence as to freedom from disintegrating tendencies. The adoption of a searching soundness test removes the necessity for a 28 days' test, and it is now axiomatic that a cement complying with the B. S. S. tests is a perfectly stable material without the evidence afforded by the 28 days' test.

It may be argued that the 28 days' test is harmless and may be allowed to remain, but in its present form at any rate it is a deterrent to progress, because finely ground cements naturally develop their strength at an early date, and do not therefore show the same increase at 28 days, which is the delayed development of strength of coarsely ground cements. The consequence is that there is a limit in the fineness to which cement may be ground, simply because the ultra-finely ground cements develop their strength too soon and thereby risk noncompliance with the Standard Specification. This early development of strength is a desideratum from the user's point of view, and ought not therefore to be discouraged by the 28 days' neat test. It may be well to point out that the early development of strength in finely ground cements does not imply stagnation at later dates, because while fineness operates to produce strength in the early stages, there are other factors in evidence during the course of succeeding months and years, and these produce continuous growth in strength, whether the cement be fine or coarse.

If, however, the 28 days' neat test is abolished, the cement user must be safeguarded against a poor quality cement which, by the help of fine grinding, just manages to reach the 450 lb. neat 7 days' test. This safeguard can be obtained by raising the 7 days' neat limit to, say, 600 lbs. per sq. in.

Turning to the sand tensile test, it has already been mentioned that this is not in line with practical conditions—first, because the proportion of cement is insufficient to to fill the voids in the standard sand, and, second, because the latter is all of one size and not graded. These differences from practice might be removed by making the sand test with a mixture of 2 or 2½ parts of sand to one part of cement, and by grading the standard sand in three different sizes, as required by the French Government Specification. Here, again, the limit of the 7 days' sand test might be raised from the present level of 200 lbs. minimum to 300 lbs., in order to exclude inferior cements.

Experience shows that the ordinary user of cement is as much or even more concerned with the strength or hardness of concrete at an age of one or two days than with its 7 days' strength, and the introduction of a tensile test at 24 or 48 hours might well be considered. Complaints concerning concrete usually center around the hardening properties at ages of two and three days, and a tensile test at this period would settle at once the question as to the responsibility of the cement for retarded hardening.

Coming to the third requirement of a cement buyer, namely, stability or freedom from expansion or disintegration, there is no doubt that the existing Le Chatelier test is sufficient safeguard in this connection. There is, indeed, reason to think that it is unnecessarily severe, but as British cement manufacturers as a whole have improved their processes to meet the specification requirements no advantage would be gained by contending for wider limits.

When a cement specification secures the essentials of setting, strength and stability, it may be argued that no further requirements need be enforced. Strictly speaking, this is true, and the additional tests specified in the British Standard may be for the purpose of eliciting desirable or interesting information of the general character of the cement, rather than for the purpose of attributing any specific value to the possession of certain properties of fineness or chemical composition. Taking the fineness test, for example: fineness of grinding in a cement is only a means to an end—the finer the cement the more are its strength and stability improved. But, if a cement having a residue on the 180 sieve of 3% or 4% above the specification limit possesses strength and stability in excess of the requirements, it is illogical to condemn the cement for its coarseness. Here, again, manufacturers have adapted themselves to the specification, and there would be no object in abolishing the fineness tests or widening the limits. The fineness test may be of value in a few cases, such as detecting a poorly manufactured cement showing the bare strength requirements of the specification and only doing so by reason of extreme fineness.

Dealing with chemical composition, the limitations of magnesia and sulphuric anhydride are necessary to exclude cements of disintegrative tendencies which would not be detected by the Le Chatelier test. The limit to insoluble matter is necessary to exclude adulterants, and the test for loss on ignition is to reveal stale and badly burnt cements. The restriction of the ratio of lime to silica and alumina is somewhat unnecessary, as slag cements are explicitly excluded, and such restriction may conceivably prevent the development of cement manufacture upon improved lines.—*Concrete and Constructional Engineering.*

The Ashburn works of E. I. du Pont de Nemours & Co., near Hannibal, Mo., resumed the manufacture of high explosives early in September. This plant was closed down about a year ago when the slump in business conditions caused a falling off in the consumption of dynamite. During the time of the shut-down, the trade logical to the plant was supplied from other operating works. The improvement in business conditions, resulting in increased demands for high explosives, makes it necessary to resume operations. The Ashburn plant has a capacity of about 15,000,000 pounds of high explosives per year.

Lime Industry in New Brunswick

By William J. McNulty.

The Canadian demand for lime has increased in 1922 over the demand for 1921. Most of the New Brunswick kilns have been active all through the spring and summer. In fact companies like the Stetson, Cutler Co., which operates two large saw mills at St. John, closed the mills at the inception of the season and did not reopen them whereas, the lime kilns connected with the Indiantown mill, at St. John, were operated without a layoff.

An American concern is seeking control of lime kilns in the maritime provinces, and offers have been made to parties owning some of the New Brunswick kilns. Boston capital is interested, it is understood, the same group being in the market for timber lands in the maritime provinces.

The three masted schooner, Hetty King, loaded 1,000 barrels of lime at St. John in August, making the trip from the port of St. John to the port of Boston in three days. This is looked on as a very fast voyage, with such a heavy cargo. Although heavy seas were encountered, the schooner striking into a gale soon after leaving the Bay of Fundy, not one barrel of lime of the big deckload was lost.

Montreal parties have sent engineers, both mineral and civil, to Charlotte County in New Brunswick to investigate the reports of heavy lime deposits along the Bay of Fundy coast. According to those who have seen these lime deposits, the quality of the lime will show splendidly, judging from the scrutiny of the rocks.

The big plant of Merrithew & Co., at Brookville, N. B., has not lost a day during the summer except Sundays. The lime burning plant is located in the heart of a large deposit of lime rock. A spur track connects the plant with the Canadian National Railway main line which is only a few hundred yards away. A rock crushing plant for supplying crushed rock for roadways and to contractors for the manufacture of concrete, is connected with the lime burning plant.

The Salmon River lime quarries and kilns have been operated since the first of April. This property is owned by the Pejepscot Pulp and Paper Co., which owns thousands of acres of timber land in the vicinity of Salmon River, and operates a paper mill at Belfast, Me. The lime is transported in lighters and towed by the company's ocean going tug, to Maine ports. Next year, the lime quarrying and burning operations of the company are likely to be enlarged.

Practically all the lime quarries and kilns along the St. John River from the mouth at the city of St. John to the upper section of the river 350 miles to the north, are operating this year. Some of the quarries that have been in disuse for many years have this year been rejuvenated and utilized. All of the lime quarrying and burning operations of the Fraser Companies, Limited, at Plaster Rock, and elsewhere in northern New Brunswick have been at the maximum.

The Cement, Tolenas & Tidewater Railroad, operating as a connecting carrier for several cement mills in California, has protested to the Interstate Commerce Commission that the tentative valuation placed upon its properties for rate-making purposes by the Commission under the Transportation Act is too low. The Commission placed a value of $127,472 on property used by the railroad for common carrier purposes and $97,390 on property owned by the carrier and used for the same purposes, as of June 30, 1916. The carrier contends that the Commission should discard its attempted valuation of that date and determine the value of its properties as of the present.

Men and Mills

Notes from the Field

Wm. A. Ernst, formerly chief chemist for the National Cement Co. at its plant at Ragland, Alabama, has resigned to accept a position with the Gulf States Portland Cement Co. at Demopolis, Ala.

Mr. Ernst was for many years connected with the plant at Ragland, from the time the plant was known as the Atlantic and Gulf and afterward as the Coosa Portland Cement Co. He was retained by the present owners, the National Cement Co., when they decided to purchase the plant.

In his new position he will have full charge of the chemical department of the Gulf States Portland Cement Co.

Chester J. Pegg, formerly assistant superintendent of the Tidewater Portland Cement Co., Union Bridge, Maryland, has been put in complete charge of the plant of the Limestone Products Corporation of America, in the capacity of general superintendent, at Newton, N. J.

During the month of July the Cement Securities Co. of Colorado, through its subsidiaries, sold 426,000 bbls. of cement. This was 16,000 bbls. in excess of the sales for the previous month. The states of Colorado, Kansas, Nebraska, Montana, Oklahoma, Arkansas, and Louisiana were the purchasers, and according to Claude K. Boettcher, vice-president, an excellent business will continue if there is an end to the rail strike.

Several months ago the Lehigh Portland Cement Co. purchased a tract of 250 acres of land at Tarrent City, a suburb of Birmingham, on which to build a cement mill. It has recently been announced that this company will commence work on a mill this fall, which will have a capacity of 1,000,000 bbls. per annum.

The Hercules Powder Co. announced a reduction of its selling prices of high explosives and B blasting powder, effective on September 18.

The Bradley Pulverizer Co. has received a contract for four of the new gear-driven Bradley Hercules mills for the new plant of the Phoenix Portland Cement Co., which is to be built at Birmingham, Ala. The Bradley company is also supplying the Dexter Portland Cement Co., Nazareth, Pa., four machines for its plant at Nazareth. Both of these companies will use the gear-driven Bradley Hercules mills for the reduction of raw material and cement clinker.

Other recent installations of the gear-driven Bradley Hercules mill were at the Marquette Cement Manufacturing Co., for reducing clinker; the Universal Portland Cement Co., at Universal, Pa., for reducing raw material; the Giant Portland Cement Co., at Egypt, Pa., for the reduction of raw material.

John Smith, foreman at the Olympic Portland Cement Co.'s plant for years, died at Puyallup September 18 as the result of injuries received when he was caught between two freight cars at the factory about a month before. He had been with the company ever since it began the construction of its plant. Mr. Smith was 55 years of age and had lived in Bellingham 33 years.

The plant of the Sandusky Cement Co., at York, Pa., where Medusa white portland cement is made, is operating regularly, having about all the business that can be taken care of with present fuel supply.

H. A. Leonard has resigned his position as superintendent of the cement department of Wellston Iron Furnace Co., Superior, Ohio, after two and one-half years of successful operation, and has accepted a position with the Gilmore Portland Cement Corp. as superintendent of quarries. The company has had a good commercial stone business until reecntly, and at the present time is unable to get sufficient cars.

The United States Coal & Coke Co., Gary, W. Va., is going to use bone coal, which was formerly considered waste, as a boiler fuel. To this end two 46-in. Fuller-Lehigh screen mills for pulverizing coal are being installed in the company's new power plant. Fuller-Kinyon distributing system will be used for conveying the pulverized coal from the mills to the furnace bins, and each 800 h. p. boiler will be equipped with five vertical burners, taking the fuel from five 3-in. screw feeders.

Owing to the good demand for cement, the Olympic Portland Cement Co. will operate until early in December, the officers of the company anticipate. Just now a shortage of cars is forcing the concern to store much of its output. Its shipments this year have been heavy.

Both plants of the Southwestern Portland Cement Co. are running and shipping at full capacity, with prospects ahead for several months at good capacity if not full capacity.

The first fall meeting of the Engineers' Club of the Lehigh Valley was planned as a joint meeting with the Lehigh Section, American Chemical Society, for October 6. An inspection trip to a number of the cement plants in the locality was planned, with the idea of covering some distinctive feature at each of the several plants.

H. H. Blaise, formerly chemist with the Gulf States Portland Cement Co., at Demopolis, Ala., is now chief chemist for the Great Western Portland Cement Co. of Kansas, located at Mildred, Kansas.

Production and shipment of cement continued in August without reduction from the extraordinary tonnage of July. Besides shipment by railroad, the cement was hauled away from the Lehigh Valley cement district by dozens of trucks directly from the mills.

Day and night packing shifts were working in many of the mills to get out the heavy shipments.

No. 2 mill of the Atlas plant at Northampton started its machinery in motion late in August. No. 4 mill of the same plant, which has been in continuous operation, will go down for several days, during which necessary repairs will be made.

John Leach, superintendent of production of the Northampton plant of the Atlas Portland Cement Co., died suddenly at his home at Catasauqua, aged 55 years. He was a native of England and fought with the British army in India and Egypt. He came to America to make plush, and later became connected with the cement industry.

The Louisville Cement Co. has suffered the loss of two valued workers, who each in his particular field served faithfully and well.

Clarence Young, assistant sales manager in the Louisville office, died of typhoid fever.

Richard Vest, foreman, died at Speed in August from the effects of the electric shock suffered while adjusting a socket. The tragedy was the result of circumstances beyond the control of even extraordinary safety precautions. Vest's clothing was wet and formed a conductor to the iron plate on which he stood. Following the shock every effort was made to revive him, trained men working over him until the last hope vanished.

The Milltown plant of the Louisville Cement Co. was forced to suspend operations at 12 o'clock August 22, on account of a coal shortage. About 150 men were thrown out of employment. The closing of the plant also shut off the lights of the town and in the houses. Every one was busy digging up the old dirty oil lamps that had been thrown away for many years.

The Alpha Portland Cement Co. recently added 5c an hour to the pay of its employees at the Cementon, N. Y., plant.

The plant of the Sandusky Portland Cement Co., at Syracuse, Ind., which for ten years gave employment to about 200 men, is rapidly being razed. The machinery is being transferred to the company's plant at Silica, Ohio, and railroad equipment operated in connection with the plant is being shipped to Toledo, Ohio.

Because of a shortage of coal the Duluth plant of the Universal Portland Cement Co. was the only one of that organization in operation for production on September 1, according to J. C. Vandoorn, northwest sales manager, at Minneapolis.

The Duluth plant was more fortunately situated than the others with respect to coal.

J. P. Toler, formerly connected with the Crescent Portland Cement Co., at Wampum, Pa., as superintendent, has severed his connection with that company.

The Cape Girardeau Portland Cement Co. has purchased its second 30-ton Ohio locomotive crane. It will be used in storing clinker during the present car shortage, and reclaiming it as shipping conditions improve. It will also assist in handling coal to and from storage.

Phoenix Portland Cement Co., in its new 1,500,000 bbl. cement plant at present being constructed near Birmingham, Ala., is installing 5 ft. 6 in. by 42 ft. indirect fired Fuller dryers for drying rock. The pulverized coal used as a fuel in these dryers and also that used as a fuel in the kilns, will be prepared in three 42-in. gear-driven Fuller mills. The pulverized coal will be conveyed from the coal preparation plant to the various furnace bins by means of a Fuller-Kinyon conveying system, with electric control; that is, the bins will be furnished with high and low indicators, which will reflect directly on a switch board in the mill room, the condition of the coal supply in the various bins. The kilns and rock dryers are also being equipped with Fuller type burners and screw feeders.

The Kosmos Portland Cement Co., Kosmosdale, Ky., is enlarging and rebuilding its coal preparation plant by installing two additional 42-in. Fuller mills.

In August, the Nazareth plant of the Phoenix Portland Cement Co. established new records in both production and shipments. The cement production was 121,000 bbls. and the shipments totaled 137,000 bbls.

The Pennsylvania Crusher Co., of Philadelphia, Pa., has recently sold one of its new hammer crushers to Phoenix Portland Cement Co. for its Birmingham, Ala., plant. Another of these crushers is part of the new equipment ordered by the Security Cement and Lime Co., which is increasing the capacity of its plant about 50%.

Employees of the Lehigh Portland Cement Co., 700 in number, returned to work on August 24 following the granting of a 20% increase in wages effective September. The men had been out on strike since August 14.

Construction operations are under way at the Universal Portland Cement Company's plant at Morgan Park involving an approximate 40% increase in portland cement production, according to reports from Duluth. The building of additional units is expected to be completed by January 1, 1923.

In an effort to do its part in the conservation of coal, the Acme Cement Co. has fitted its power plant with an oil-burning device, which will save fuel for other purposes. All the power used for lights and for running machinery is now being furnished with heat derived from oil.

An increase of 12½% in the price of cement has been put into effect by a number of the cement companies in the Lehigh district, making the price $2.25 per bbl., plus the bag cost, at the mill. However, most of the companies have sold so much of the product in advance that the increase will only be felt in isolated cases.

Wage advances accorded laborers in the steel mills adjacent to the cement manufacturing plants in the Lehigh Valley district are said to be responsible for the increase, because the companies had to meet the wage increase granted the steel workers or lose their laborers.

Labor is none too plentiful at the plant of the Clinchfield Portland Cement Co. Coal is hard to get. In spite of these facts, all previous records as regard to output and shipping have been broken to date this year.

Another kiln and dryer are being installed, bringing clinker production to 4,000 bbls. per day. This expansion is planned to meet the rapidly increasing demand for the Clinchfield company's product. Construction is now in progress, and it is expected to have the work completed by November 1.

Among the improvements which will be made at the plant of the Dewey Portland Cement Co., after the fall rush is over, will be included the building of four more reinforced concrete storage tanks of 20,000 bbls. each and another sacking plant in connection therewith.

Firing ends 9½ ft. in size are to be added to each of the 8 ft. kilns, and it is expected that the capacity of the kilns will be increased about 25%. Large dust collectors will be put on the stacks of the waste heat boilers. Steel is already on the ground to put larger bunkers over the raw grinding tube mills and mix tanks.

In August coal became impossible to obtain, and the company put in fuel oil, which had been prepared for about a month previously, and now that coal is again available, the change has been made back to coal.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of Cement Mill Edition of Concrete, published monthly at Detroit, Michigan, for October 1, 1922.

State of Michigan, }
County of Wayne, } ss.

Before me, a Notary Public, in and for the State and County aforesaid, personally appeared R. Marshall, who, having been duly sworn according to law, deposes and says that he is the General Manager of the Cement Mill Edition of Concrete, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in Section 443, Postal Laws and Regulations, printed on the reverse side of this form, to-wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher—Concrete-Cement Age Pub. Co., Detroit, Mich.
President—R. Marshall, Detroit, Mich.
Managing Editor—Harvey Whipple, Detroit, Mich.
General Manager—R. Marshall, Detroit, Mich.

2. That the owners are (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent. or more of the total amount of stock).

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R. Marshall, 1807 E. Grand Blvd., Detroit, Mich.
Harvey Whipple, 1807 E. Grand Blvd., Detroit, Mich.
F. F. Lincoln, Room 1205, Broadway, New York City.
R. N. Jackson, 1807 E. Grand Blvd., Detroit, Mich.
R. W. Lesley, Penn Bldg., Philadelphia, Pa.
Edward B. Bruce, Manila, P. I.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities, are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest, direct or indirect, in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers, during the six months preceding the date shown above is ——— This information is required from daily publications only.)

R. MARSHALL,
Manager.

Sworn to and subscribed to before me this 28th day of September, 1922.

(Seal.) IONE MICHAEL.
(My commission expires April 9, 1923.)

Trade Publications

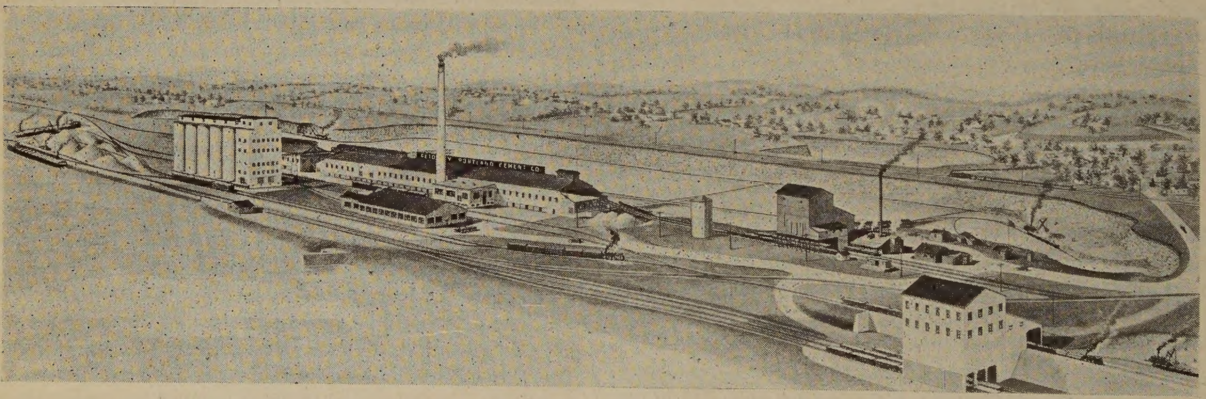
Standard and Narrow Gauge Railroad Equipment, by L. B. Foster Co., Inc., Pittsburgh, Pa. This is a four-page illustrated pamphlet, 8½ x 11 in., containing interesting information about rails, frogs, switches, and complete track installation for all purposes, including mills, factories, quarries and contractors' plants.

The Brown Instrument Co., of Philadelphia, Pa., announce the publication of a new resistance thermometer catalog which explains the theory of resistance thermometry, the various types of instruments which are made, and the merits of each type, suggesting the field which this instrument so ideally covers.

Operating as it does upon the basis of electrical resistance, rather than pressure, it is designed to do away with many of the handicaps of the pressure type thermometer. Very great accuracy and extremely rapid speed of action are claimed in its favor.

Alligator Steel Belt Lacing, by Flexible Lacing Co., Chicago, Ill. This is an illustrated folder, descriptive of separable hinge fasteners for tape belts and light leather and fabric belting. In joining belts with the separable hinge fasteners, nothing is required but a hammer. Among the points of advantage claimed for the Alligator, are smooth and flexible separable hinge joints, and saving of time by avoiding machine delays.

Cleveland Worm Gear Reduction Unit, by the Cleveland Worm and Gear Co., Cleveland, Ohio. This is an illustrated catalog, 7½ in. by 10½ in., 104 pp., paper cover. Installations of Cleveland worm drives in various industries are illustrated. Specifications as well as a number of pages of formulae and data useful in calculating worm gearing are also included.



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